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ABSTRACT

This module is intended to give students a better understanding of the factors involved in home design that relate to energy consumption. Students are given an introductory page followed by a set of directions for a home design game. One class period is required to accomplish the activities of this module. (Author/RE)

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SE 030 918

"If You Save A Buck, It's Not Sheer Luck"
or
How to Save Energy in Home Design

By Nancy Landes

Unit Title: Net Energy

Module Title: "If You Save a Buck, It's Not Sheer Luck" or How to Save Energy in Home Design

Description of Module: This module is designed to give the students a better understanding of the many factors involved in home design that relate to energy consumption in the home. The students are given an introductory page followed by a set of directions for a home design game called "If You Save a Buck, It's Not Sheer Luck." Many aspects of home design are related to energy consumption in this short game.

Unit Objectives Met: 2b,2f,2g,2h,3c.

Materials Needed: Game cards, score sheets, pencils, student pages.

Module Type: Alternative.

Context: Social Science, Home Economics.

Time Required: One class period.

Mode: Game, discussion.

Sample Evaluation Items

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Teacher's Guide

This module is designed to give the students a better understanding of the many factors involved in home design that relate to energy consumption in the home. As mentioned on the first student page, residential space heating accounts for 11.8% of national energy use. Because this percentage is a national average, northern home owners are responsible for the majority of this energy use.

In this module, the students are given an introductory page followed by a set of directions for a home design game called "If You Save a Buck, It's Not Sheer Luck." The individual cards for the home game are included in the teacher materials. You will need to duplicate the card sets to produce as many as you will need for your students. The cards are printed with a situation on one side (marked with **) and answers on the back. If possible, the cards should be printed on thick enough paper so that the students cannot see through to the answers on the back.

We have presented the students with one set of directions for playing the game. Many variations exist: 1) You could ask the students to work in teams of 2 and keep a team score for how well they answer the questions. Then the team scores throughout the room could be compared. (This would be a more competitive approach). 2) The students could go through the cards individually and keep their own scores for later comparison. 3) You could have groups of 4 students with 2 teams of 2 students each. Each team would

act as an individual player (drawing a card and choosing an answer) and then the 2 teams would compete for top scores. 4) Because all the cards are different with some more difficult than others, you may want each card to be answered separately by each player. Both players could read the card together (or a monitor could read the card aloud to the class), record an answer, then look on the back for the correct answers and points awarded. Other alternatives are possible; you will want to choose what you feel is best for your class.

The game is designed to take approximately 20 minutes of class time. You will want to allow time for discussion following the game. Excellent references exist for this information. In fact, the references listed are those from which most of the game items were drawn. The references are located on the reference page in the back of this guide.

Possible Follow-up Activities:

1. Research various home designs for energy consumption:

   a) underground homes
   b) solar homes
   c) homes using wood for fuel
   d) wind powered home generating systems
   e) passive solar homes
   f) other

2. Find out about different home designs around the world. What climatic factors affect the materials and designs used in different parts of the world? What building materials are available for use?

3. Model home building: Ask individual students to design energy efficient homes and build scale models of these.

STUDENT GUIDE

Part I

Energy is consumed by all sectors of our society: industrial, commercial, transportation, and residential. In this module, you will take a closer look at the residential sector and the energy used by individual residences. As energy use is computed nationwide, industry is responsible for roughly 41%, the commercial sector for 14% and the transportation sector for 25%. This leaves 20% of our nation's energy use in the residential sector, the sector where you and your family live. This means that 20% of the energy we use as a nation can be controlled by individual families at home.

How is this 20% of the nation's energy actually used in homes? The breakdown looks something like this:

Space Heating	57.5%
Water Heating	14.9%
Refrigeration	6.0%
Cooking	5.5%
Air Conditioning	3.7%
Clothes Drying	1.8%
Other	10.6%

(Other includes lighting, freezers, washing machines, dishwashers, and all other household appliances.)

As you can see, most of the energy consumed in homes is used for keeping them warm (space heating.) In fact, space heating can be figured to be 11.5% of the nation's total energy consumption - almost as much as the entire commercial sector.

In more northern climates, more than 57% of the energy used in a home is used for space heating. (Remember that 57.5% is a national average with more

being used in the north and less in the south to come to an average of 57.5%). Some estimates place the energy used in northern homes for heating at 75% of the total energy used in a home. This, then, becomes a major factor for families to consider in northern climates. This also provides these families with more incentives and opportunities to conserve this energy.

How can you begin to look at energy conservation at home? Play the "If You Save a Buck, It's Not Sheer Luck" Game and pick up some pointers. The directions follow.

"If You Save a Buck, It's Not Sheer Luck" (directions)

This game is for two players. One player draws a card from the stack and reads the information on the card. This player then makes a choice from the answers given by choosing the one answer that will most likely reduce energy used for space heating. The player states this choice to his opponent. The player turns the card over and reads the answers given. The player records the points given for his or her chosen answer on the score sheet. (Score sheet explained later.) Then the second player takes a turn and follows the same procedure. The first player to reach 30 points wins the game.

Score Sheet

Turns	Player 1	Player 2
1	+2	-1
2		
3		
4		
5		

Player one receives a score from his/her card. This score is recorded in the small box next to turn 1. Let's say the score was +2. Then player 2 scores -1 for choosing an incorrect answer. The players then total their scores in the larger adjacent box.

The score sheet will appear as follows:
Assume these scores:

	Player 1	Player 2
Turn 1	+2	-1
Turn 2	-1	+3
Turn 3	+3	+1
Turn 4	+2	+3
Turn 5	-1	0

Turns	Player 1	Player 2
	+2	-1
1	+2	-1
	-1	+3
2	+1	+2
	+3	+1
3	+4	+3
	+2	+3
4	+6	+6
	-1	0
5	+5	+6

Player 2 is ahead after five turns.

Notes: These situations and answers were prepared from data we had available. If you find you do not agree with the answers given and can find documentation for a better answer, you may change the card. Also, if you find other information from which a new card could be written, write another card and add it to the game. (Your information should have a source other than yourself, though.)

You may argue that some of the choices given are not practiced from an economic (money) point of view or that the correct answer does not go along with what you would choose to do if you really were presented with this choice. Remember that the game is designed only to relate to energy use in a home, not personal values you may have. We realize that most decisions are based on many factors, not just one. These would be valuable issues to raise in discussion following the game. Have fun and think in terms of cutting energy costs!

Teacher Comment

Emphasize that the choices to be made are energy choices only. One card asks about the possibility of changing jobs to move further south. Of course, few people decide to move south only because their heating bills will decrease, but that is the only way the question is to be read. In this case family, friends, recreation possibilities, etc. are not to be considered. These points may be brought out in discussion.

SCORE SHEET

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**You are following the building progress of your home and notice that the builders are ready to install the outlets for your kitchen appliances. Your furnace is located directly under one end of the kitchen. You should:

1--be sure the contractors install the refrigerator above the furnace. (The refrigerator gives off heat as it cools food and will add to the heat coming from the furnace.

2--be sure the contractors install the stove above the furnace because the heat from the furnace will not detract from the efficiency of the stove.

***

**You have a woodlot on your land where you plan to selectively cut wood to maintain the lot. You have enough wood to provide you with a supplementary heating source. You decide to:

1--build in a Franklin wood stove.

2--build an open fireplace in the living room.

3--build a fireplace with glass doors and a heat circulating firebox.

***

**You find that your roof has been leaking seriously and after checking it over, the whole roof should be replaced. You should consider:

1--dark colored roofing to absorb as much winter sun as possible.

2--light colored roofing to keep the summer heat reflected.

***

**You have decided to remodel an older home instead of building your own. (You live in one of the northern states, by the way). As you look over the house, you notice that the hot water pipes run along the outside wall of the house. You decide to:

1--reroute the pipes to run along the inside walls.

2--leave the pipes as they are.

1--Most heat efficient. You could greatly supplement your heating system with such a stove. (Your score +2)

2--Esthetic but inefficient. 90% of the heat from the wood goes up the chimney. (Your score -2)

3--This will increase the efficiency of the fireplace but most of the heat would still be lost up the chimney. (Your score -1)

1--This is a poor choice because the heat from your furnace will be constantly working against the cooling action of your refrigerator. Because of this, your refrigerator's motor will probably be running most of the time. (Your score -1)

2--This is a good choice. The 2 sources of heat can add to one another and not cause one to work more often than needed. (Your score + 1)

1--This would be a good idea if you care to tackle the job because hot water pipes along the outside walls tend to freeze up more easily in winter and also lose heat by conduction to the outside air as the hot water flows through them. (Your score +2)

2--Because of expense or other factors, you may decide to leave the pipes as they are. This will detract from the heating efficiency of your home, however. (Your score - 1)

1--The dark colored roofing will reduce the need for winter heating somewhat, but not enough to make much difference. (Your score 0)

2-- Light colored roofing does <u>significantly</u> reduce the need for summer cooling. (In a study of single family residences, the change from a white roof to a black roof only slightly reduced the heating load while increasing the cooling load substantially). (Your score +2)

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**New architectural forms are introduced to your area. You are interested in building:

1--a modern expansive one-story home that has many large glass windows.

2--an underground home that has a south facing exposure.

***

**You are looking over apartments to rent while you are in college. You will have to pay the heating bills in this particular building. You decide to:

1--rent the center apartment although you only have two south windows.

2--rent the corner apartment because the view is better.

***

**You live in a large home and do not care to move. You have your thermostat set at 65° in the daytime and 55° at night in winter. To conserve more energy and still maintain maximum comfort, you should:

1--turn your thermostat lower and dress more warmly.

2--discontinue heating those rooms that are used less often and keep them closed off from the heated portion of the house.

***

**You want to use natural vegetation to aid in winter heating and summer cooling. You decide to:

1--plant a row of evergreen trees on the windward side of your house.

2--plant deciduous trees near the north and east sides of the house.

1--You will save on your heating bills because you have heat sources on either side of your apartment. (Your score +3)

2--You have more exposed wall area and will pay for the view in higher heating costs. (Your score - 1)

1--You will have alot of surface area exposed to wind and temperature changes. Also, glass is a poor building material because it conducts heat as the temperature changes on the outside as compared to the inside. (Heat moves through the glass to the outside air.) (Your score - 3)

2--These homes are very energy efficient because the earth stays at a fairly constant temperature and provides a natural insulation for the living space. Little additional heat is needed in winter. (Your score + 2)

1--These trees will reduce the heat loss from your house in winter by acting as a windbreak. They also help cool your home in the summer through evaporation of moisture. (Your score + 3)

2--Deciduous trees take advantage of the winter sun and shade your home from the summer sun, but not if they are planted on the north and east sides of the house. They need to be on the south and west sides to be effective. (Your score 0)

1--This will conserve more energy but will not allow for much comfort. Temperatures below 65°, although tolerable, are not especially comfortable. (Your score + 1)

2--This would cause less hardship and will conserve energy. Keeping bedrooms at a constant 55° can be practical if you do not need to use the bedrooms for study rooms, TV rooms, etc. If you do lower heat in certain rooms, be sure to keep them tightly sealed from the heated portion of the house or you will lose more heat than you save. (Your score +3)

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**You have installed a clock thermostat in your home. Your best settings for comfort and energy savings for day/night would be:

1--68°/55° winter; 78° summer

2--72°/65° winter; 65° summer

***

**You are finalizing the plans for your home with your contractor. He has drawn in a furnace that will burn natural gas. You decide to:

1--agree with his recommendation.

2--install an electric heating system.

***

**You are considering a heating system for your home. You decide to:

1--call the local utility and go along with what they recommend.

2--call a furnace company and agree with their recommendation.

3--call the library and energy information office for information on furnaces.

***

**You are looking for homes to buy. You find two homes that are very similar except for their size. You choose:

1--an adequate home with 7 rooms (1800 square feet of living space)

2--a roomier home with 2100 square feet of living space.

1--Good choice because natural gas can be piped directly into your furnace and gas furnaces, when properly maintained, heat with a 70 to 80% efficiency. (Your score +2)

2--Electric heat is not energy efficient. This heating source is a secondary source because it is produced from fossil fuels at the power plant before being sent through the wires to your home. (Your score -2)

1--is the best choice. With plenty of blankets, 55° for nighttime heat is not uncomfortable and 68° is a better setting than 72° for energy and health considerations during the day. A general reduction in thermostat setting for heating results in a savings of about 3% for each degree. Each degree of increase for cooling results in a savings of 5%. (Your score +3)

2--(Your score -2)

1--This home would need less energy for heating in the winter and cooling in the summer. (Your score +3)

2--Although 300 sq. ft. doesn't seem like much difference, this home would need more energy for heating in winter and cooling in summer. (Your score -1)

1--This could be a biased source although most utilities are publishing good consumer information. (Your score 0)

2--Another biased source although companies should carry efficiency data on the products they sell. (Your score 0)

3--This decision is one of the major ones you will need to make concerning your home and its energy use. You made a wise decision to investigate information before proceeding. (Your score +3)

***

**Your contractors are finishing your home. You go to check on the work and notice that the thermostat is placed on the wall directly next to your stove. You decide to:

1--leave well enough alone. The thermostat wouldn't be affected much by the stove since it's only used three times a day.

2--ask the contractor to move the thermostat to an interior wall of the living room.

***

**You are planning to move. You decide to buy a:

1--townhouse.

2--single family home.

3--mobile home.

***

**You have decided to add insulation to your attic. You notice that each package of insulation has an R-value on it. You assume the R-value relates to:

1--thickness in inches of insulation to add.

2--the resistance of the insulation to heat passing through it.

***

**Your dream is to live in the country. You decide to:

1--buy land and build your home to take advantage of the natural landscaping.

2--buy an older farm house and remodel it to improve heating efficiency.

1--This is more efficient to heat. (Your score is +3)

2--Too many rooms here; your heating bill skyrockets. (Your score -2)

3--This provides you with a smaller heating space but it is poorly insulated. Conduction problems occur on all sides--floor as well as roof and walls. (Your score -2)

1--The heat from the stove will affect the thermostat. Instead of registering the general temperature of the house, the thermostat will record the temperature of the air heated by the stove. (Your score -3)

2--The thermostat should be located away from heat sources and sunlight and away from cool or drafty areas. (Your score +3)

1--Moving to the country increases your transportation energy costs, but you save on your heating bills by taking advantage of sunshine and wind direction. (Your score + 1)

2--You increase your transportation costs and because you must make substantial repairs and add alot of insulation, your investment takes years to repay. (Your score -2)

1--Thickness should never be confused with R-values. Very thick insulation with a low R-value will not do you as much good as less insulation with a higher R-value. (Your score -2)

2--Yes!! Insulation is rated as to how well it does its job--preventing heat from moving through it. Higher R-values mean that less heat will escape through the insulation and therefore from your house. (Your score +3)

***

**You have recently moved into an apartment building and have begun to meet your neighbors. You notice that your apartment seems to be the warmest one in the building even though everyone keeps the thermostats set at 68°. That is because your apartment is:

1--on a lower level on the north side.

2--on the top floor on the south side.

3--on the middle floor on the west side.

***

**In building your home, you decide to:

1--place the bedrooms on the west side of the house and the living room on the east.

2--place the living room on the west side of the house and the bedrooms on the east.

***

**Before moving to the country, you check with the utility companies to see what options you have for home heating. You are not interested in solar collectors or heating with wood. You decide to:

1--remain in the city.

2--move to the country as you had planned.

***

**Your company is offering a position similar to the one you now hold in one of the southern states. You decide to:

1--stay in your present location.

2--move south to accept the new position.

1--The bedrooms become unbearably hot due to the hot afternoon sun in summer and the living room needs additional heat in the winter because it receives only morning sun. (Your score - 1)

2--The rooms will be more comfortable because the living area receives the warm afternoon sun while the bedrooms remain cool. In summer the living rooms can be shaded and the bedrooms will be more comfortable for sleeping. (Your score +2)

1--A lower level, north facing apartment will probably be the coldest apartment in the building something to consider if you pay for your own heat. (Your score -1)

2--Because heat rises, the upper apartments would be warmer. The south windows take the best advantage of the sun in all seasons. (Your score + 1)

3--This apartment would be fairly warm in winter, but probably not as warm as those on the upper floors. (Your score 0)

1--Your heating costs stay the same. (Your score 0)

2--You pay less each winter for heating. (Your score +2)

1--You have more options for home heating fuel. Natural gas, which is a more efficient fuel generally, is available in city areas but not usually in the country. (Your score +1)

2--You only have 3 options for heating sources: oil, propane gas, and electric heat. Oil and propane are becoming more and more expensive and less available. Electric heat is expensive and has a low efficiency overall because it is a secondary heating source. (Your score -1)

***

**You have recently bought a mobile home. As you decide on a lot, you look for one that offers the best use of environmental conditions. You find just the lot you have been looking for and it:

1--allows you to position your mobile home so the long sides face east and west.

2--allows you to position your mobile home so the long sides face north and south.

***

**You are tired of paying high heating costs so you decide to insulate your home. You begin by insulating the attic. Your next most cost-effective step is to:

1--insulate all exterior walls.

2--insulate the walls and ceilings between the unheated garage and the living area.

3--insulate the ceiling between the unheated basement and living area.

***

**You have found an ideal home but the heating system is supplied by electric heat. You know this is an inefficient source but the house is perfect for you otherwise. You should consider:

1--having the electric system converted to gas or oil.

2--installing solar collectors to provide an alternate heating source.

3--installing a heat pump to increase the efficiency of the system.

***

**You are not concerned with conventional home structure. You decide to build your house with 40 inch thick concrete blocks. This turned out to be:

1--a wise choice because your house suffered very little from conduction.

2--a mistake because concrete has poor insulating qualities.

1--This is an expensive task if your house is already built. It means blowing insulation in through holes cut in the outside siding. This step is an effective one, but not as cost effective as the other. (Your score + 1)

2--This is the most cost-effective of the three choices. Because the garage is exposed to the outside air, more conduction is probably occurring along walls/floors connected to the house. (Your score + 3)

3--This would be the second choice. The basement is somewhat insulated by the earth around it so it wouldn't offer as much in savings as the surfaces touching the garage. (Your score + 1)

1--You will not be able to take advantage of the winter sun and the summer afternoon sun will really cause a heat problem in your home. (Your score - 2)

2--The north/south facing provides you with maximum value from the sun. You can install a tall fence and plant a windbreak if winds from the north are a problem. (Your score + 2)

1--Thickness does not mean less conduction over the long run. Even with 40" of concrete your house would not be well insulated. (Your score - 2)

2--40 inch concrete walls provide only as much insulating properties as 1" of dense fiber glass insulation. Your concrete walls would probably have to be insulated with more fiberglass or other insulation to be effective against conduction in winter and summer. The thickness itself is not effective. (your score + 1)

1--Converting your heating system from electric heat to a furnace system would be a major undertaking and might not save as much as the initial investment. (Your score - 1)

2--Solar collectors are a viable alternative in some areas of the country, but are probably not as cost effective in the northern U.S. as a heat pump would be. (Your score + 1)

3--This is the best choice. A heat pump works in winter by transferring heat from the outside air (anything above 20 ^{o}F) to the home at a higher temperature and by doing the reverse in the summer. A heat pump requires half the electricity of a conventional electric heating system. (Your score + 3)

***

**You have decided to build a well insulated house for energy efficiency in the winter. You choose:

1--brick as your basic material for construction.

2--stone as your basic material for construction.

3--wood as your basic material for construction.

***

**You have just moved into an older home that is well constructed. Winter is approaching and you have enough money to make one investment. Your money would be most wisely spent by:

1--installing storm windows.

2--adding 3 inches of insulation in the attic only.

3--thoroughly caulking and weather-stripping your home.

***

**You have purchased a large lot for your new home. You need at least 8 rooms (including kitchen and bath) to house your family comfortably. You decide to:

1--build a 2-story home and maintain a lush green lawn with a minimum of trees and shrubs.

2--build a 2-story home with a smaller front lawn and a larger back yard which you can landscape.

3--build a large one story home so you won't have as much yard to maintain.

***

**Your new home is almost ready... You have some last minute decisions to make--one of those concerns your windows. You choose to:

1--have the contractors install aluminum-glass/screen combination windows.

2--have the contractors design storm windows to fit over the wood frame windows for the winter.

3--have your home fitted with double glazed windows and no storms.

1--good investment but not the best, contributes 13-25% of total energy savings. (Your score +2)

2--best investment you could make; contributes 47% to total energy savings. (Your score + 4)

3--again a good idea, but not as effective as adding insulation. (Your score + 1)

1 or 2--Brick and stone have very low R-values. They would be poor materials to use for a well insulated home because of their higher conductivity. (More warm air will pass through the brick and stone from the inside to the outside in winter and vice versa in summer). (Your score - 1)

3--Wood has better insulating properties than either brick or stone. (Your score +2)

1--single pane windows are <u>not</u> effective in maintaining heat levels. Aluminum frames also allow for more conduction. (Your score - 1)

2--Storm windows are effective in decreasing the heat loss by half from your home. Wise decision. (Your score + 3)

3--Double glazed windows (which are 2 panes of glass factory sealed together with a small air space between them) are as effective as storm windows because of the small air space maintained between the 2 panels of glass. Another wise decision. (Your score +3)

1--This home would be more efficient because the heated volume has less surface area than a one-story home of equal volume. But, maintenance of a lush green lawn could be highly energy intensive. (Your score - 1)

2--This is the best choice. You have a more compact heated area and you have more landscaping possibilities for enhancing use of solar radiation and control of wind factors. (Your score + 3)

3--This home would take more energy to heat because of its large surface area (unless it were very well insulated). You won't save much even if you cut back your yard maintenance.

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**You are interested in buying a home. Before you begin looking, you should decide on the level of energy efficiency you desire. The <u>first</u> thing you should decide is:

1--what size home you and your family require.

2--the basic design of the home you are looking for.

3--the type of heating system you want in your home.

***

**You live in a mobile home and want to make it more energy efficient. Probably the first thing you should do is:

1--add storm windows and doors to the mobile home.

2--add a foundation or skirt to the mobile home.

***

**You notice alot of static electricity in your home in the winter. This means that your home has dry air. This is:

1--a good sign because dry air is more comfortable in winter, easier to heat, and better for your health.

2--a bad sign because dry air is less comfortable in winter, harder to keep heated, and less healthy for your family.

***

**Winter is approaching and you are trying to get your house in good shape for the months ahead. Your furnace is fairly new so you decide to:

1--turn it on for a few minutes to be sure it is working properly.

2--call in a heating specialist to service your furnace.

1--This would help, but not as much. (Your score + 1)

2--This is your best investment because it closes off the area under the mobile home. Some space needs to be provided for air circulation but the foundation greatly reduces conduction and infiltration from the floor area. (Your score + 3)

1--This is the most important consideration, although the others are important. Your heating bills will be determined to a great extent by how much area you need to heat. (Your score + 3)

2--Many home designs can be energy efficient especially if the homes are properly insulated. Size is a more important consideration than design. (Your score + 1)

3--If you are not building your own home, you will be more restricted in this area. Looking for a home based on the type of heating system it has is not a practical first step. This could be more of a factor in deciding between a few selected possibilities. (Your score + 1)

1--Turning on your furnace to see if it is working tells you nothing about how long it will continue to work during the winter. (Your score - 1)

2--Having your furnace serviced every winter will probably save you money and energy over the long run. Your furnace will run more efficiently after it has been serviced, the filters have been changed, and it has been thoroughly cleaned. (Your score +2)

1-- (Your score - 1)

2--is the correct answer. In winter, outside air is cold and holds less moisture. As this air enters the house and passes through it, the humidity becomes very low. This lower humidity increases the rate of evaporation of moisture from the skin and produces a cold sensation even at fairly warm temperatures. Humidification can save energy by permitting a lower air temperature while maintaining comfort. (Your score + 1)

***

**You have increased your savings and are ready to purchase a home. You decide to:

1--build your own home.

2--buy an older home which is $10,000 less expensive.

***

**You have decided to live in the more temperate zone of the U.S. (Tennessee, Kentucky region) You choose:

1--to look for an energy efficient house (one with insulation, weather-stripping, etc.) so you don't have to do the work yourself.

2--not to worry about the amount of insulation because the winters are not severe and insulation will make the house even hotter in the summer.

**YOU HAVE AN ACE IN THE HOLE. THIS IS A SNARF JOKER WORTH + 3 POINTS.

**YOU HAVE AN ACE IN THE HOLE. THIS IS A SNARF JOKER WORTH + 3 POINTS.

1--You will have made the better investment here because a well insulated, weatherstripped house will protect you from summer's heat as well as winter's wrath. Insulation reduces heat flow in either direction. (Your score + 3)

2--You will pay for this negligence in higher fuel bills in the winter and summer, especially if you air-condition your home. If you don't air condition, you will suffer physically from the heat conducted from the outside to the inside. (Your score - 3)

1--You have the option of adding energy saving features which will substantially cut your yearly heating costs. (Your score + 3)

2--You will pay high heating costs and will need to spend an additional $8,000 to add necessary insulation and make repairs. (Your score - 1)

JOKER — SNARF ENERGY SAVER

YOU RECEIVE + 3 EXTRA POINTS

JUST FOR LUCK !!!

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JUST FOR LUCK!!!

Evaluation Items

1. In general, the factor(s) most effective in conserving home heat is (are):

   a. storm windows and doors.
   b. weatherstripping.
   c. insulation.
   d. a gas furnace.

   (ANSWER - C)

2. Residential energy users are responsible for

   a. 20% of U.S. energy use.
   b. 42% of U.S. energy use.
   c. 57% of U.S. energy use.
   d. 10% of U.S. energy use.

   (ANSWER -A)

3. The best way for residential users to help our energy situation is to:

   a. install solar panels.
   b. employ conservation measures.
   c. build new houses.
   d. use electric heating.

   (ANSWER - B)

4. The thermostat setting that is recommended for comfort and conservation in winter is:

   a. 70° - 72° daytime/68° nighttime.
   b. 65° -68° daytime/55° nighttime.
   d. 55° daytime/ 65° nighttime.

   (ANSWER - B)

5. The design of your home is important in relation to the amount of energy your home will use.

   Circle one: True False

   (ANSWER - TRUE)

6. Electric heat is an efficient type of heat for your home.

   Circle one: True False

   (ANSWER - FALSE)

7. List 3 ways to make an existing home more energy efficient.

   1.
   2.
   3.

   **Possible answers: Adding insulation, adding storm windows and doors, caulking and weatherstripping, setting thermostats properly, closing off unheated rooms, etc.

8. List 3 considerations in building an energy efficient home.

   1.
   2.
   3.

   **Possible answers: orientation of home, installing an efficient heating system, building in insulation landscaping, size, number and location of windows, etc.

REFERENCE

1. Energy Conservation In the Home, U.S. Department of Energy, 1977.
   Order from:
   U.S. DEPARTMENT OF ENERGY
   Technical Information Center
   P.O. Box 62
   Oak Ridge, Tennessee 37830
   (Free of Charge)

2. Save Energy, Save Dollars, Cooperative Extension, Cornell University, New York. Order from:
   MAILING ROOM
   Building 7,
   Research Park
   Cornell University
   Ithaca, New York 14853
   (Price $1.50)

STUDENT GUIDE

Part I

Energy is consumed by all sectors of our society: industrial, commercial, transportation, and residential. In this module, you will take a closer look at the residential sector and the energy used by individual residences. As energy use is computed nationwide, industry is responsible for roughly 41%, the commercial sector for 14% and the transportation sector for 25%. This leaves 20% of our nation's energy use in the residential sector, the sector where you and your family live. This means that 20% of the energy we use as a nation can be controlled by individual families at home.

How is this 20% of the nation's energy actually used in homes? The breakdown looks something like this:

Space Heating	57.5%
Water Heating	14.9%
Refrigeration	6.0%
Cooking	5.5%
Air Conditioning	3.7%
Clothes Drying	1.8%
Other	10.6%

(Other includes lighting, freezers, washing machines, dishwashers, and all other household appliances.)

As you can see, most of the energy consumed in homes is used for keeping them warm (space heating.) In fact, space heating can be figured to be 11.5% of the nation's total energy consumption - almost as much as the entire commercial sector.

In more northern climates, more than 57% of the energy used in a home is used for space heating. (Remember that 57.5% is a national average with more

being used in the north and less in the south to come to an average of 57.5%). Some estimates place the energy used in northern homes for heating at 75% of the total energy used in a home. This, then, becomes a major factor for families to consider in northern climates. This also provides these families with more incentives and opportunities to conserve this energy.

How can you begin to look at energy conservation at home? Play the "If You Save a Buck, It's Not Sheer Luck" Game and pick up some pointers. The directions follow.

"If You Save a Buck, It's Not Sheer Luck" (directions)

This game is for two players. One player draws a card from the stack and reads the information on the card. This player then makes a choice from the answers given by choosing the one answer that will most likely reduce energy used for space heating. The player states this choice to his opponent. The player turns the card over and reads the answers given. The player records the points given for his or her chosen answer on the score sheet. (Score sheet explained later.) Then the second player takes a turn and follows the same procedure. The first player to reach 30 points wins the game.

Score Sheet

Turns	Player 1	Player 2
1	+2	-1
2		
3		
4		
5		

Player one receives a score from his/her card. This score is recorded in the small box next to turn 1. Let's say the score was +2. Then player 2 scores -1 for choosing an incorrect answer. The players then total their scores in the larger adjacent box.

The score sheet will appear as follows:
Assume these scores:

	Player 1	Player 2
Turn 1	+2	-1
Turn 2	-1	+3
Turn 3	+3	+1
Turn 4	+2	+3
Turn 5	-1	0

Turns	Player 1	Player 2
1	+2	-1
2	+1	+2
3	+4	+3
4	+6	+6
5	+5	+6

Player 2 is ahead after five turns.

Notes: These situations and answers were prepared from data we had available. If you find you do not agree with the answers given and can find documentation for a better answer, you may change the card. Also, if you find other information from which a new card could be written, write another card and add it to the game. (Your information should have a source other than yourself, though.)

You may argue that some of the choices given are not practiced from an economic (money) point of view or that the correct answer does not go along with what you would choose to do if you really were presented with this choice. Remember that the game is designed only to relate to energy use in a home, not personal values you may have. We realize that most decisions are based on many factors, not just one. These would be valuable issues to raise in discussion following the game. Have fun and think in terms of cutting energy costs!

SCORE SHEET

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***

**You are following the building progress of your home and notice that the builders are ready to install the outlets for your kitchen appliances. Your furnace is located directly under one end of the kitchen. You should:

1--be sure the contractors install the refrigerator above the furnace. (The refrigerator gives off heat as it cools food and will add to the heat coming from the furnace.

2--be sure the contractors install the stove above the furnace because the heat from the furnace will not detract from the efficiency of the stove.

***

**You have a woodlot on your land where you plan to selectively cut wood to maintain the lot. You have enough wood to provide you with a supplementary heating source. You decide to:

1--build in a Franklin wood stove.

2--build an open fireplace in the living room.

3--build a fireplace with glass doors and a heat circulating firebox.

***

**You find that your roof has been leaking seriously and after checking it over, the whole roof should be replaced. You should consider:

1--dark colored roofing to absorb as much winter sun as possible.

2--light colored roofing to keep the summer heat reflected.

***

**You have decided to remodel an older home instead of building your own. (You live in one of the northern states, by the way). As you look over the house, you notice that the hot water pipes run along the outside wall of the house. You decide to:

1--reroute the pipes to run along the inside walls.

2--leave the pipes as they are.

1--Most heat efficient. You could greatly supplement your heating system with such a stove. (Your score +2)

2--Esthetic but inefficient. 90% of the heat from the wood goes up the chimney. (Your score -2)

3--This will increase the efficiency of the fireplace but most of the heat would still be lost up the chimney. (Your score -1)

1--This is a poor choice because the heat from your furnace will be constantly working against the cooling action of your refrigerator. Because of this, your refrigerator's motor will probably be running most of the time. (Your score -1)

2--This is a good choice. The 2 sources of heat can add to one another and not cause one to work more often than needed. (Your score + 1)

1--This would be a good idea if you care to tackle the job because hot water pipes along the outside walls tend to freeze up more easily in winter and also lose heat by conduction to the outside air as the hot water flows through them. (Your score +2)

2--Because of expense or other factors, you may decide to leave the pipes as they are. This will detract from the heating efficiency of your home, however. (Your score - 1)

1--The dark colored roofing will reduce the need for winter heating somewhat, but not enough to make much difference. (Your score 0)

2-- Light colored roofing does <u>significantly</u> reduce the need for summer cooling. (In a study of single family residences, the change from a white roof to a black roof only slightly reduced the heating load while increasing the cooling load substantially). (Your score +2)

***

**New architectural forms are introduced to your area. You are interested in building:

1--a modern expansive one-story home that has many large glass windows.

2--an underground home that has a south facing exposure.

***

**You are looking over apartments to rent while you are in college. You will have to pay the heating bills in this particular building. You decide to:

1--rent the center apartment although you only have two south windows.

2--rent the corner apartment because the view is better.

***

**You live in a large home and do not care to move. You have your thermostat set at 65° in the daytime and 55° at night in winter. To conserve more energy and still maintain maximum comfort, you should:

1--turn your thermostat lower and dress more warmly.

2--discontinue heating those rooms that are used less often and keep them closed off from the heated portion of the house.

***

**You want to use natural vegetation to aid in winter heating and summer cooling. You decide to:

1--plant a row of evergreen trees on the windward side of your house.

2--plant deciduous trees near the north and east sides of the house.

1--You will save on your heating bills because you have heat sources on either side of your apartment. (Your score +3)

2--You have more exposed wall area and will pay for the view in higher heating costs. (Your score - 1)

1--You will have alot of surface area exposed to wind and temperature changes. Also, glass is a poor building material because it conducts heat as the temperature changes on the outside as compared to the inside. (Heat moves through the glass to the outside air.) (Your score - 3)

2--These homes are very energy efficient because the earth stays at a fairly constant temperature and provides a natural insulation for the living space. Little additional heat is needed in winter. (Your score + 2)

1--These trees will reduce the heat loss from your house in winter by acting as a windbreak. They also help cool your home in the summer through evaporation of moisture. (Your score + 3)

2--Deciduous trees take advantage of the winter sun and shade your home from the summer sun, but not if they are planted on the north and east sides of the house. They need to be on the south and west sides to be effective. (Your score 0)

1--This will conserve more energy but will not allow for much comfort. Temperatures below 65°, although tolerable, are not especially comfortable. (Your score + 1)

2--This would cause less hardship and will conserve energy. Keeping bedrooms at a constant 55° can be practical if you do not need to use the bedrooms for study rooms, TV rooms, etc. If you do lower heat in certain rooms, be sure to keep them tightly sealed from the heated portion of the house or you will lose more heat than you save. (Your score +3)

***

**You have installed a clock thermostat in your home. Your best settings for comfort and energy savings for day/night would be:

1--68°/55° winter; 78° summer

2--72°/65° winter; 65° summer

***

**You are finalizing the plans for your home with your contractor. He has drawn in a furnace that will burn natural gas. You decide to:

1--agree with his recommendation.

2--install an electric heating system.

***

**You are considering a heating system for your home. You decide to:

1--call the local utility and go along with what they recommend.

2--call a furnace company and agree with their recommendation.

3--call the library and energy information office for information on furnaces.

***

**You are looking for homes to buy. You find two homes that are very similar except for their size. You choose:

1--an adequate home with 7 rooms (1800 square feet of living space)

2--a roomier home with 2100 square feet of living space.

1--Good choice because natural gas can be piped directly into your furnace and gas furnaces, when properly maintained, heat with a 70 to 80% efficiency. (Your score +2)

2--Electric heat is not energy efficient. This heating source is a secondary source because it is produced from fossil fuels at the power plant before being sent through the wires to your home. (Your score -2)

1--is the best choice. With plenty of blankets, 55° for nighttime heat is not uncomfortable and 68° is a better setting than 72° for energy and health considerations during the day. A general reduction in thermostat setting for heating results in a savings of about 3% for each degree. Each degree of increase for cooling results in a savings of 5%. (Your score +3)

2--(Your score -2)

1--This home would need less energy for heating in the winter and cooling in the summer. (Your score +3)

2--Although 300 sq. ft. doesn't seem like much difference, this home would need more energy for heating in winter and cooling in summer. (Your score -1)

1--This could be a biased source although most utilities are publishing good consumer information. (Your score 0)

2--Another biased source although companies should carry efficiency data on the products they sell. (Your score 0)

3--This decision is one of the major ones you will need to make concerning your home and its energy use. You made a wise decision to investigate information before proceeding. (Your score +3)

***

**Your contractors are finishing your home. You go to check on the work and notice that the thermostat is placed on the wall directly next to your stove. You decide to:

1--leave well enough alone. The thermostat wouldn't be affected much by the stove since it's only used three times a day.

2--ask the contractor to move the thermostat to an interior wall of the living room.

***

**You are planning to move. You decide to buy a:

1--townhouse.

2--single family home.

3--mobile home.

***

**You have decided to add insulation to your attic. You notice that each package of insulation has an R-value on it. You assume the R-value relates to:

1--thickness in inches of insulation to add.

2--the resistance of the insulation to heat passing through it.

***

**Your dream is to live in the country. You decide to:

1--buy land and build your home to take advantage of the natural landscaping.

2--buy an older farm house and remodel it to improve heating efficiency.

1--This is more efficient to heat. (Your score is +3)

2--Too many rooms here; your heating bill skyrockets. (Your score -2)

3--This provides you with a smaller heating space but it is poorly insulated. Conduction problems occur on all sides--floor as well as roof and walls. (Your score -2)

1--The heat from the stove will affect the thermostat. Instead of registering the general temperature of the house, the thermostat will record the temperature of the air heated by the stove. (Your score -3)

2--The thermostat should be located away from heat sources and sunlight and away from cool or drafty areas. (Your score +3)

1--Moving to the country increases your transportation energy costs, but you save on your heating bills by taking advantage of sunshine and wind direction. (Your score + 1)

2--You increase your transportation costs and because you must make substantial repairs and add alot of insulation, your investment takes years to repay. (Your score -2)

1--Thickness should never be confused with R-values. Very thick insulation with a low R-value will not do you as much good as less insulation with a higher R-value. (Your score -2)

2--Yes!! Insulation is rated as to how well it does its job--preventing heat from moving through it. Higher R-values mean that less heat will escape through the insulation and therefore from your house. (Your score +3)

***

**You have recently moved into an apartment building and have begun to meet your neighbors. You notice that your apartment seems to be the warmest one in the building even though everyone keeps the thermostats set at 68°. That is because your apartment is:

1--on a lower level on the north side.

2--on the top floor on the south side.

3--on the middle floor on the west side.

***

**In building your home, you decide to:

1--place the bedrooms on the west side of the house and the living room on the east.

2--place the living room on the west side of the house and the bedrooms on the east.

***

**Before moving to the country, you check with the utility companies to see what options you have for home heating. You are not interested in solar collectors or heating with wood. You decide to:

1--remain in the city.

2--move to the country as you had planned.

***

**Your company is offering a position similar to the one you now hold in one of the southern states. You decide to:

1--stay in your present location.

2--move south to accept the new position.

1--The bedrooms become unbearably hot due to the hot afternoon sun in summer and the living room needs additional heat in the winter because it receives only morning sun. (Your score - 1)

2--The rooms will be more comfortable because the living area receives the warm afternoon sun while the bedrooms remain cool. In summer the living rooms can be shaded and the bedrooms will be more comfortable for sleeping. (Your score +2)

1--A lower level, north facing apartment will probably be the coldest apartment in the building something to consider if you pay for your own heat. (Your score -1)

2--Because heat rises, the upper apartments would be warmer. The south windows take the best advantage of the sun in all seasons. (Your score + 1)

3--This apartment would be fairly warm in winter, but probably not as warm as those on the upper floors. (Your score 0)

1--Your heating costs stay the same. (Your score 0)

2--You pay less each winter for heating. (Your score +2)

1--You have more options for home heating fuel. Natural gas, which is a more efficient fuel generally, is available in city areas but not usually in the country. (Your score +1)

2--You only have 3 options for heating sources: oil, propane gas, and electric heat. Oil and propane are becoming more and more expensive and less available. Electric heat is expensive and has a low efficiency overall because it is a secondary heating source. (Your score -1)

***

**You have recently bought a mobile home. As you decide on a lot, you look for one that offers the best use of environmental conditions. You find just the lot you have been looking for and it:

1--allows you to position your mobile home so the long sides face east and west.

2--allows you to position your mobile home so the long sides face north and south.

***

**You are tired of paying high heating costs so you decide to insulate your home. You begin by insulating the attic. Your next <u>most cost-effective</u> step is to:

1--insulate all exterior walls.

2--insulate the walls and ceilings between the unheated garage and the living area.

3--insulate the ceiling between the unheated basement and living area.

***

**You have found an ideal home but the heating system is supplied by electric heat. You know this is an inefficient source but the house is <u>perfect</u> for you otherwise. You should consider:

1--having the electric system converted to gas or oil.

2--installing solar collectors to provide an alternate heating source.

3--installing a heat pump to increase the efficiency of the system.

***

**You are not concerned with conventional home structure. You decide to build your house with 10 inch thick concrete blocks. This turned out to be:

1--a wise choice because your house suffered very little from conduction.

2--a mistake because concrete has poor insulating qualities.

1--This is an expensive task if your house is already built. It means blowing insulation in through holes cut in the outside siding. This step is an effective one, but not as cost effective as the other. (Your score + 1)

2--This is the most cost-effective of the three choices. Because the garage is exposed to the outside air, more conduction is probably occurring along walls/floors connected to the house. (Your score + 3)

3--This would be the second choice. The basement is somewhat insulated by the earth around it so it wouldn't offer as much in savings as the surfaces touching the garage. (Your score + 1)

1--You will not be able to take advantage of the winter sun and the summer afternoon sun will really cause a heat problem in your home. (Your score - 2)

2--The north/south facing provides you with maximum value from the sun. You can install a tall fence and plant a windbreak if winds from the north are a problem. (Your score + 2)

1--Thickness does not mean less conduction over the long run. Even with 40" of concrete your house would not be well insulated. (Your score - 2)

2--40 inch concrete walls provide only as much insulating properties as 1" of dense fiber glass insulation. Your concrete walls would probably have to be insulated with more fiberglass or other insulation to be effective against conduction in winter and summer. The thickness itself is not effective. (your score + 1)

1--Converting your heating system from electric heat to a furnace system would be a major undertaking and might not save as much as the initial investment. (Your score - 1)

2--Solar collectors are a viable alternative in some areas of the country, but are probably not as cost effective in the northern U.S. as a heat pump would be. (Your score + 1)

3--This is the best choice. A heat pump works in winter by transferring heat from the outside air (anything above 20 $^{\circ}$F) to the home at a higher temperature and by doing the reverse in the summer. A heat pump requires half the electricity of a conventional electric heating system. (Your score + 3)

***

**You have decided to build a well insulated house for energy efficiency in the winter. You choose:

1--brick as your basic material for construction.

2--stone as your basic material for construction.

3--wood as your basic material for construction.

***

**You have just moved into an older home that is well constructed. Winter is approaching and you have enough money to make one investment. Your money would be most wisely spent by:

1--installing storm windows.

2--adding 3 inches of insulation in the attic only.

3--thoroughly caulking and weather-stripping your home.

***

**You have purchased a large lot for your new home. You need at least 8 rooms (including kitchen and bath) to house your family comfortably. You decide to:

1--build a 2-story home and maintain a lush green lawn with a minimum of trees and shrubs.

2--build a 2-story home with a smaller front lawn and a larger back yard which you can landscape.

3--build a large one story home so you won't have as much yard to maintain.

***

**Your new home is almost ready... You have some last minute decisions to make--one of those concerns your windows. You choose to:

1--have the contractors install aluminum-glass/screen combination windows.

2--have the contractors design storm windows to fit over the wood frame windows for the winter.

3--have your home fitted with double glazed windows and no storms.

1--good investment but not the best, contributes 13-25% of total energy savings. (Your score +2)

2--best investment you could make; contributes 47% to total energy savings. (Your score + 4)

3--again a good idea, but not as effective as adding insulation. (Your score + 1)

1 or 2--Brick and stone have very low R-values. They would be poor materials to use for a well insulated home because of their higher conductivity. (More warm air will pass through the brick and stone from the inside to the outside in winter and vice versa in summer). (Your score - 1)

3--Wood has better insulating properties than either brick or stone. (Your score +2)

1--single pane windows are <u>not</u> effective in maintaining heat levels. Aluminum frames also allow for more conduction. (Your score - 1)

2--Storm windows are effective in decreasing the heat loss by half from your home. Wise decision. (Your score + 3)

3--Double glazed windows (which are 2 panes of glass factory sealed together with a small air space between them) are as effective as storm windows because of the small air space maintained between the 2 panels of glass. Another wise decision. (Your score +3)

1--This home would be more efficient because the heated volume has less surface area than a one-story home of equal volume. But, maintenance of a lush green lawn could be highly energy intensive. (Your score - 1)

2--This is the best choice. You have a more compact heated area and you have more landscaping possibilities for enhancing use of solar radiation and control of wind factors. (Your score + 3)

3--This home would take more energy to heat because of its large surface area (unless it were very well insulated). You won't save much even if you cut back your yard maintenance.

***

**You are interested in buying a home. Before you begin looking, you should decide on the level of energy efficiency you desire. The first thing you should decide is:

1--what size home you and your family require.

2--the basic design of the home you are looking for.

3--the type of heating system you want in your home.

***

**You live in a mobile home and want to make it more energy efficient. Probably the first thing you should do is:

1--add storm windows and doors to the mobile home.

2--add a foundation or skirt to the mobile home.

***

**You notice alot of static electricity in your home in the winter. This means that your home has dry air. This is:

1--a good sign because dry air is more comfortable in winter, easier to heat, and better for your health.

2--a bad sign because dry air is less comfortable in winter, harder to keep heated, and less healthy for your family.

***

**Winter is approaching and you are trying to get your house in good shape for the months ahead. Your furnace is fairly new so you decide to:

1--turn it on for a few minutes to be sure it is working properly.

2--call in a heating specialist to service your furnace.

1--This would help, but not as much. (Your score + 1)

2--This is your best investment because it closes off the area under the mobile home. Some space needs to be provided for air circulation but the foundation greatly reduces conduction and infiltration from the floor area. (Your score + 3)

1--This is the most important consideration, although the others are important. Your heating bills will be determined to a great extent by how much area you need to heat. (Your score + 3)

2--Many home designs can be energy efficient especially if the homes are properly insulated. Size is a more important consideration than design. (Your score + 1)

3--If you are not building your own home, you will be more restricted in this area. Looking for a home based on the type of heating system it has is not a practical first step. This could be more of a factor in deciding between a few selected possibilities. (Your score + 1)

1--Turning on your furnace to see if it is working tells you nothing about how long it will continue to work during the winter. (Your score - 1)

2--Having your furnace serviced every winter will probably save you money and energy over the long run. Your furnace will run more efficiently after it has been serviced, the filters have been changed, and it has been thoroughly cleaned. (Your score +2)

1-- (Your score - 1)

2--is the correct answer. In winter, outside air is cold and holds less moisture. As this air enters the house and passes through it, the humidity becomes very low. This lower humidity increases the rate of evaporation of moisture from the skin and produces a cold sensation even at fairly warm temperatures. Humidification can save energy by permitting a lower air temperature while maintaining comfort. (Your score + 1)

***

**You have increased your savings and are ready to purchase a home. You decide to:

1--build your own home.

2--buy an older home which is $10,000 less expensive.

***

**You have decided to live in the more temperate zone of the U.S. (Tennessee, Kentucky region) You choose:

1--to look for an energy efficient house (one with insulation, weather-stripping, etc.) so you don't have to do the work yourself.

2--not to worry about the amount of insulation because the winters are not severe and insulation will make the house even hotter in the summer.

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1--You have the option of adding energy saving features which will substantially cut your yearly heating costs. (Your score + 3)

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